

THURSDAY, SEPTEMBER 28, 1899.

INCANDESCENT GAS LIGHTING.

L'éclairage à Incandescence. Par P. Truchot. Pp. x + 255. (Paris : Georges Carré et C. Naud, 1899.)

IN looking back to the achievements of the past half-century, few domestic improvements will strike the observer more forcibly than the advances made in the development of light from coal gas. In the early fifties the metal flat flame and argand burners were looked upon as so satisfactory and so little likely to find a rival, that practically no efforts were made to improve them, and it was only in 1852 when the late Sir Edward Frankland first made his double chimney argand—afterwards known as the Bowditch burner—in which he led the air supply down between two glass cylinders surrounding the flame, and so utilised some of the heat which would otherwise have been wasted to heat the air supplied to the flames, and found as the result a distinct increase in illuminating power, that the idea arose that it was possible to obtain more than the two to three candles of light per cubic foot of gas consumed which the best burners then gave.

Frankland's burner marks the inception of the idea of regeneration as applied to an illuminating flame, an idea perfected by Siemens in 1879 and followed by a number of regenerative burners which doubled, and in some cases nearly trebled, the light obtainable from coal gas as compared with the ordinary burner.

At the same period that the regenerative burner was struggling into prominence, Bourbouze, and later Lewis, devised a method of producing light from coal gas by burning it in a long bunsen burner, and making the flame impinge upon a mantle of fine platinum gauze, which heated to high incandescence gave more light than would have been emitted by the gas if burnt in an ordinary burner; and although this process never achieved much success owing to the fact that platinum soon got acted upon and lost its power of light emissivity, yet it was undoubtedly the forerunner of the incandescent mantle of to-day which has revolutionised our ideas as to artificial illumination, and yields ten times as much light for the same gas consumption as the ordinary No. 5 flat flame burner.

So important has incandescent lighting become, and so abundant is the literature with regard to it, that the time had clearly arrived for it to be collected and welded into a handbook that should prove a guide and companion to all working in this branch of industry. This task has been undertaken by M. Truchot, who in "L'éclairage à incandescence par le gaz et les liquides gazéifiés" has given us a concise record of the history of incandescent lighting and a work of both theoretical and practical importance.

In the twelve chapters of which the book consists, the author passes in review the properties and production of light, photometry, the proper distribution of light, the theories of Drossbach, St. John, Westphaal, Killing, Bunte and others who have attempted to explain the cause of the high incandescence of the metallic oxides forming the mantle skeleton, an excellent history of in-

candescent lighting and a full account of the various minerals employed as a source of the rare earths and their treatment. Especially valuable will be found the description of the various methods of making the mantle and the chief points to be observed.

The author then passes to the various forms of bunsen burner, and the results which can be obtained from them, but hardly gives sufficient credit to Bandsept's inventions, which practically cover the ground upon which the chief advances in this direction have since been made. It would have been better also if a chapter had been devoted to the theory of the bunsen burner, as it would have made the differences existing between the various forms of burner clearer.

Very excellent in its way also is the chapter devoted to the lighting of the burners, and the effect which this has upon the life of the mantle. The author also goes fairly fully into incandescent mantle lamps for use with alcohol, petroleum and other easily gasifiable hydrocarbons.

The book concludes with a review of the use of incandescent lighting for railway carriages, lighthouses, photography, &c., and comparisons of incandescent light with other systems; whilst the list of French patents for mantles and burners forms a useful finish to the work.

M. Truchot has done his work well, and his book should be in the hands of everybody interested in incandescent mantle lighting.

AN AMERICAN TEXT-BOOK OF GEOMETRY.

New Plane and Solid Geometry. By W. W. Beman and D. E. Smith. Pp. x + 382. (Boston, U.S.A. : Ginn and Co., 1899.)

THE Americans are an eminently practical people, and in seeking for the path of least resistance towards any desired end they are happily free from the shackles of inherited prejudice and irrational reverence for established tradition. This makes their mathematical textbooks very instructive reading; and although in some cases the desire for simplicity leads to a certain superficiality, this reproach cannot be fairly applied to their mathematical literature as a whole. Every reasonable person must admit that the simplest way of demonstrating a mathematical truth is the best one; and that energy wasted on the rudiments is so much loss of valuable time which might have been spent with profit otherwise.

The "New Plane and Solid Geometry," which is a revised edition of a work first published in 1895, illustrates very well the attitude of two experienced and competent American professors towards the problem of teaching elementary geometry. It is not to be expected that their work will meet with universal approval in all its details; but it has many conspicuous merits which cannot fail to commend themselves, and deserves to be carefully studied by every teacher, whatever his personal views may be.

The first thing to notice is the order and proportion which the authors have succeeded in maintaining. After a short, but very useful, introduction, there are eight Books dealing respectively with rectilineal figures; equality of polygons; circles; ratio and proportion; mensuration and regular polygons; lines and planes in

space ; polyhedra ; the cylinder, cone and sphere, and similar solids. At the end of the book will be found numerical tables, a biographical table, a table of etymologies and an index. The space allotted to the different sections is comparable with their relative importance, and proper emphasis is laid on fundamental ideas such as congruence, symmetry and similarity.

Another very important feature is that the student is consistently stimulated and encouraged to think for himself. Marginal queries are frequently inserted, in order that he may justify the statements in the text ; and some of the proofs are given merely in outline for the reader to fill up in detail. On the other hand, figures and hints are given with the more difficult exercises. The appendix to Book iii., and other paragraphs inserted from time to time, ought to be of great help in teaching the student how to acquire the difficult art of proceeding from the unknown to the known by the method of analysis.

In the theory of parallels, the authors adopt Playfair's axiom ; and their treatment of ratio is entirely arithmetical. In their opinion the purely geometric treatment is too difficult for the beginner. On this point opinions differ, and will probably continue to do so : at the same time the arithmetical theory is here given in as nearly rigorous a form as the beginner is likely to appreciate. Thus it is properly stated as an assumption that a geometric magnitude may be represented by a number ; and the transition from the commensurable to the incommensurable case is made by the classic process of exhaustion. Of course the strict arithmetical theory is at least as hard as the geometrical one, because it involves, besides the assumption above stated, either Dedekind's theory of irrational numbers or something equivalent to it.¹ But there is something to be said in favour of beginning with a provisional theory, admittedly imperfect, to be made more precise later on. It would be easy to add, in a future edition, an appendix giving the strict arithmetical and geometrical theories.

In the discussion of the mensuration of the circle and other similar questions, the authors have avoided an error into which writers who adopt the arithmetical method are very apt to fall. They explicitly state the assumption that the circumference of a circle is the limit of the perimeter of an inscribed or circumscribed regular polygon, and then make use of the proved proposition that if, while approaching their respective limits, two variables have a constant ratio, their limits have that ratio. It is rather curious, by the by, that they omit to prove that the volume of a pyramid is the limit of the sum of the volumes of the usual set of inscribed prisms.

In the text, which is beautifully printed by the Athenaeum Press, free use is made of abbreviations. The notation ab for the rectangle contained by the segments denoted by a and b will be objected to by some people ; but it really needs no justification, because the analogy which it suggests is too useful to be ignored, and if the student

¹ It may be remarked, in passing, that Euclid's test of the equality of two ratios really amounts to the establishment of the identity of two *Schnitte*, as Dedekind calls them ; for if $mA >= nB$ according as $mC >= nD$, the series of rational numbers m/n for which $mA > nB$ defines a *Schnitt*, and this is identical with the series for which $mC > nD$.

cannot, after due warning, distinguish ab , the area of a rectangle, from ab , the product of two numbers, it is entirely his own fault.

The figures are very good ; those on solid geometry have been very carefully drawn, and are nearly as effective as models would be. This is a great help to the beginner : he should bear in mind, however, that he must eventually be able to use a less pictorial figure, or even construct a diagram mentally in cases where an actual figure is too complicated to be useful. We should be rather inclined to suggest beginning with the more pictorial figures, and gradually reducing them to pure diagrams. Between a picture and a diagram there is the same sort of difference as there is between a photograph of an electrometer and a working drawing of the same instrument.

G. B. M.

OUR BOOK SHELF.

An Elementary Course of Mathematics. By H. S. Hall and F. H. Stevens. Pp. ix + 342. (London : Macmillan and Co., Ltd., 1899.)

IN preparing this book the object kept in mind was, as we are told in the preface, to provide in a simple and inexpensive volume a short course of arithmetic, algebra and Euclid specially adapted to the requirements of students who, after leaving school, desire to continue their study of elementary mathematics by partly attending evening classes and partly working privately at home.

To attain the end in view, the compilers, in the first portion on arithmetic, have restricted themselves to simply providing the student with a series of progressive exercises arranged to extend over a winter session of thirty weeks ; a few additions, exercises with notes and hints, conclude this portion.

Algebra is next dealt with, and no previous knowledge is here assumed, so that a progressive but elementary course with numerous examples is given, covering the usual ground up to quadratic equations. In the last section on Euclid only the first book is considered. In the case of each proposition a few notes and exercises will help the reader to master this book, while additional theorems and a large set of appropriate examples are added for further practice.

For the purpose for which it is intended, this elementary course is well adapted.

Carvell's Nursery Handbook, with Hints. By J. M. Carvell. Pp. 70. (London : Barber, 1899.)

THE contents of this "Nursery Handbook" are arranged under a number of headings ; for instance, "The Nursery," "Sleeping," "Clothing," "Feeding," &c. But in each section the hints given seem to be selected at haphazard ; small details in some places are noted, while many points of importance are omitted.

In fact, the book seems too disjointed to be of real value, and the information too scanty to serve as a practical guide. In many instances the directions are so short that without amplification they might easily be misinterpreted.

Chats about the Microscope. By Henry C. Shelley. Pp. 101. (London : The Scientific Press, Ltd., 1899.)

YOUNG naturalists will find in this volume many useful hints on the collection and preparation of common objects for microscopical study, and will be guided to make observations of a number of minute organisms easily obtained.